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NATURAL ENGINEERING BRANCH

500-1-69

OUTDOOR THERMOSTAT FOR FAN VENTILATION CONTROL

The reason why an outdoor thermostat is preferred to control ventilation rate is that the indoor temperature does not always indicate the moisture level in the barn. This may further be explained by drawing your attention to the following chart.

This chart indicates the moisture content of air at various temperatures at 100% relative humidity. Outdoor conditions in cold weather are usually 85 to 95% R. H. The moisture conditions in a hog barn should not exceed approximately 75% R. H. to prevent condensation. At 55°, 75% R. H. the moisture content of air is 3.68 grains per cu. ft. 7000 grains = 1 pound.

<u>Temperature</u>	<u>Moisture content (M. C.)</u> <u>(Grains per cu. ft. 100% R.H.)</u>	<u>3.68 - M. C.</u>
-20°	0.17	3.51
-10°	0.28	3.40
0°	0.47	3.21
+10°	0.77	2.91
+20°	1.24	2.44
+30°	1.94	1.74
+40°	2.86	0.82
+50°	4.11	
+60°	5.79	

55°, 75% R. H. = 3.68

To obtain the figures in column three of the chart, the moisture content of the outdoor air was subtracted from 3.68, the moisture content of indoor air at 55° and 75% relative humidity. The value in column three then represents the amount of moisture which may be removed with every cubic foot of ventilating air. In actual winter conditions these figures are very realistic because outdoor humidity is often near 100%. We also do not want the relative humidity in the barn to exceed 75%.

During warm summer conditions these figures do not apply because the relative humidity of outdoor air is usually lower, and indoor conditions will be much warmer and more humid. Condensation is no longer a problem, however, other problems may arise.

Referring again to column three we see that at 0° or lower over four times as much moisture may be removed by one cubic foot of ventilating air as at 40° (3.21 compared to 0.82). Conversely, this means that the ventilation rate at 40° should be four times the rate at 0°. For this reason some device is required to increase the ventilating rate as outdoor temperatures increase.

Note again on column three of the chart that there is a rather sharp drop in the effective ventilation between +10° and +30°; (1.94 - 0.77 = 1.17)

From -20° to 0° there is only a difference of 0.30. For this reason, reasonably effective control of the ventilating rate may be achieved by bringing in a larger amount of air when the outdoor temperature is approximately $+20^{\circ}$. Even better conditions would result if a portion of this air is turned on at $+15^{\circ}$ and another increase be made at 30° . It becomes practical to do this in large buildings where three or more fans are required.

The use of outdoor temperature control is most important for a heated building such as a farrowing hog barn. The major fault of an indoor temperature control on the ventilating fans is that the furnace or heater will keep the building sufficiently warm that the full volume of air will be flowing, thus resulting in excessive fuel bills to keep the building warm. This happens when the fan thermostat is set at a temperature lower than the furnace control.

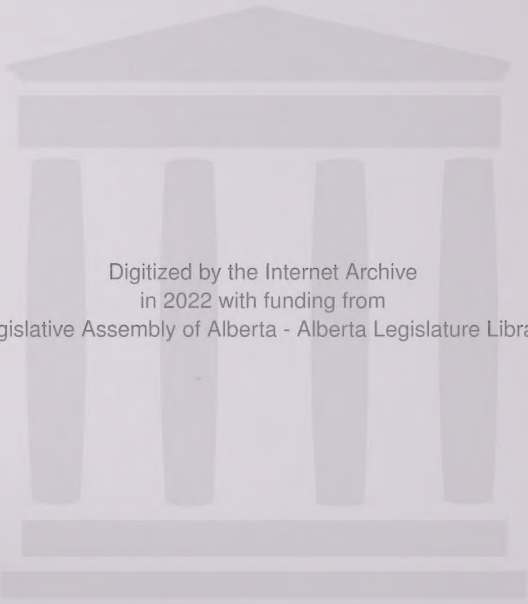
If the fan thermostat is set higher than the furnace there will be many times when the humidity in the building will reach a serious level and the inside temperature will not be high enough to actuate the fan control and bring in more air.

In the first situation the barn conditions will be warm and dry but a tremendous heating cost may be incurred. For this reason this type of control should never be used. The second condition (fan thermostat set higher than the furnace control) will be more practical but situations will occur when high humidity will result in condensation and foul, unhealthy conditions in the barn due to lack of ventilation when it is required.

The solution to both these conditions is to locate the fan control outside and regulate the amount of ventilating air by means of outdoor temperature. If the fans are properly sized there should be very little excess heat required and the proper inside conditions will be maintained. It may be necessary to experiment with the outdoor thermostat to obtain the best temperature at which the larger amount of ventilating air be brought in however, this will most likely be between 15° and 25° .

Whether or not outdoor ventilation control should be used for buildings which are not heated, such as feeder hog barns, is perhaps not as important as for heated buildings. Reasonable control may be obtained with an indoor thermostat set on one or more fans, with one fan running continually to provide the minimum amount of air required. This fan must be properly sized according to the amount of hogs in the building. With this arrangement the humidity may become excessively high in the barn before the temperature is high enough to actuate the second fan or fans.

This same fan arrangement may be controlled by an outdoor thermostat set at approximately 20° . It will be important that this temperature be regulated so that the minimum amount of air will flow continually, and the larger ventilating rate be used only when the outdoor temperature is approaching the point where condensation occurs or the humidity is becoming too high in the building. In most cases slightly better results may be obtained when the ventilating rate is controlled by outdoor temperature.



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